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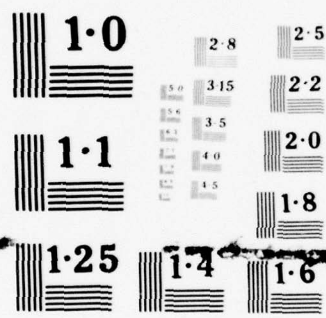

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

USNS HAYES Marine Boundary Layer

Research Cruise:

Preliminary Evaluation of NPS Data

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NAVAL POSTGRADUATE SCHOOL
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This report summarizes the participation of the Naval Postgraduate School aboard the USNS Hayes on a marine boundary layer research cruise in the North Atlantic and Mediterranean. The equipment which was installed aboard the ship and the types of measurements made are described. Tables of the mean and fluctuating data taken are presented as well as some preliminary evaluation of the data.

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ABSTRACT

This report summarizes the participation of the Naval Postgraduate School aboard the USNS HAYES on a marine boundary layer research cruise in the North Atlantic and Mediterranean. The equipment which was installed aboard the ship and the types of measurements made are described. Tables of the mean and fluctuating data taken are presented as well as some preliminary evaluation of the data.

I. INTRODUCTION

In May and June of 1977 the Naval Air Systems Command (AIR 370) sponsored a marine boundary layer research cruise aboard the Naval Research Laboratory (NRL) ship, USNS HAYES, in the North Atlantic and Mediterranean. The cruise involved scientific personnel from several laboratories including the Naval Postgraduate School (NPS). We departed Chetham Annex, Virginia on May 15, paralleled the Coast to Novia Scotia, then took a great circle route across the Atlantic arriving in Rota, Spain on May 27. We departed Rota, Spain on May 30 and arrived in Piraeus, Greece on June 7.

NPS participated in the cruise primarily to gather atmospheric turbulence data for a wide range of atmospheric and sea state conditions. These data are used to determine turbulent fluxes of heat, momentum, and water vapor and turbulent mixing of other atmospheric scalars such as aerosols, electric change and pollutants. The data are also important for characterizing the optical propagation qualities of the atmosphere. This is a preliminary report on the basic mean and turbulence data gathered by the NPS personnel.

II. USNS HAYES INSTALLATION

The USNS HAYES (T-AGOR 16) is a twin hull ship that was constructed for NRL for use as an oceanographic research vessel. Pertinent dimensions are: length overall 246 ft, beam 75 ft, and distance between hulls 27 ft. Due to the catamaran construction the ship has a very broad forward wall beginning approximately 50 ft back from the bows of the ship, which extends nearly the full width of the ship and to a height of approximately 56 ft above the mean water line. The presence of this wall greatly perturbs the natural airflow and causes problems in the interpretation of our data, as will be described.

Figure 1 shows the profile of the ship and the location of the two stations at which NPS installed sensors. We welded a 12 ft tubular steel tower as far forward on the bow as possible (approximately 2 ft back from the tip of the bulwark). The mean sensors were placed at the top of this tower and the turbulence sensors were mounted on a wind vane, which was mounted on a 4 ft extension at the top of the tower. The vane is used to keep the sensors pointing into the wind, and the extension places the sensors forward of the tower so that shipboard influence is eliminated. The second station was located on the first level of the ships mast. Again, the turbulence sensors were mounted on a vane on an extension to keep these sensors as far forward of the platform as was feasible. The arrangement at this station was such that the mean sensors were approximately 2 ft below the turbulence sensors. The height of the various sensors above the mean water level were:

STATION	SENSOR ht.		EFFECT. ht. (tunnel)		EFFECT. ht. (meas.)	
	MEAN	TURB	MEAN	TURB	MEAN	TURB
BOW	12.1m	12.1m	11.3m	11.3m	11.0m	11.0m
MAST	23.8m	24.5m	17.6m	18.5m	19.6m	20.5m

Table I. Height of Sensors Above Mean Sea Level.

Figure 1 shows a schematic representation of the air flow over the ship when the relative wind is from the bow. The effect of the flow is that the air sampled by the sensors at the mast station comes from a height lower than their actual height above the sea surface. The location of the bow station is such that the air sampled comes from nearly the same height as the sensors.

Before the 1975 fog cruise, NRL had a wind tunnel analysis of the air flow around the Hayes performed. Also, during that cruise, Dr. Richard Jeck of NRL made a number of measurements of the wind velocity in the forward region of the ship with a bivane anemometer. Evaluation of these two sets of data do not give us as accurate information as we need, but they do show that the air arriving at the mast rises approximately 20 ft. This correction is applied to the height, giving the air height listed in Table I as effective height (tunnel). Note that the air flow information that is available is only for the relative wind directly from the bow at about 10 knots. We have made a better estimate of the effective heights from the ratio of turbulent dissipation, ε, at the two heights. In the boundary layer,

$$Z_1/Z_2 = (\varepsilon_2/\varepsilon_1)\ f_\varepsilon\ (Z_1/L)/f_\varepsilon\ (Z_2/L)$$

where $f_\varepsilon(Z/L)$ is a stability correcting factor and L is the Monin-Obukhov length (a typical value for the Northern oceans is $L \cong -100$ meters). For this cruise we have 230 simultaneous values of ε_1 and ε_2 giving

$$< \varepsilon_1/\varepsilon_2 > \ = \ 1.97$$

which results in

$$Z_2/Z_1 \ = \ 1.86.$$

Assuming the bow level is much less affected than the mast we have assigned the values of Z_1 and Z_2 given in the third column of Table I.

III. NPS Equipment

1) General Information

We installed equipment to measure both mean and turbulence parameters at both the bow and mast stations. The parameters measured were:

a. humidity

b. temperature

c. horizontal wind speed

d. temperature fluctuations

e. horizontal wind speed fluctuations

A sea surface temperature sensor was installed between the hulls about 75 ft forward of the stern. Relative wind direction was measured at the bow level.

Details of the equipment used for the measurements follows.

The sensors for both mean humidity and mean temperature were mounted in a single aspirator at each station. They were, therefore, protected from the weather while a steady flow of air insured that they remained at ambient conditions.

2) Humidity:

A Hygrodynamics Digital II system employing 15-1818 sensors was used. The sensors contain lithium chloride cells and thermistors so that humidity and temperature were both measured continuously. This temperature sensor was used only as a monitor, not for our mean temperature measurements. The humidity sensors were calibrated in a humidity chamber, the results are shown in Table II. Sensor #2 was used on the bow level and Sensor #6 was used on the mast.

Hygrodynamics Digital II Calibration

Wet-Dry Bulb %RH	Ave Hygro %RH	Deviation of Sensor from Ave Hygro % RH 1	2	3	4	5	6	7	8
33.0	31.6	1.4	-1.4	-0.6	1.5	-0.2	-1.6	-0.9	1.8
36.0	37.2	-0.5	-0.8	-0.3	1.6	0.5	-1.4	-0.1	1.2
44.0	41.2	-0.8	-0.4	-0.3	0.6	0.9	0.4	-0.1	0.3
NA	41.5	-0.5	-0.4	-0.3	0.5	0.9	-0.4	-0.1	-0.1
NA	42.6	-1.2	-0.5	-0.5	-0.9	1.8	-0.4	-0.2	0.1
NA	65.8	-0.2	-1.4	-2.5	0.8	1.8	-0.3	1.3	0.3
74.8	73.6	0.2	0.2	-1.3	0.5	-0.2	0.4	-0.4	0.8
88.3	85.0	-0.7	0.9	-0.4	0.1	-0.6	0.0	0.4	0.2
82.6	86.7	-1.4	-0.6	-0.5	0.1	-0.2	0.3	0.7	0.3
82.6	87.0	-1.0	0.5	-0.7	0.0	0.3	0.7	0.0	0.2
85.0	88.0	-0.4	1.1	-0.1	0.1	-1.8	1.1	-0.6	-0.1
93.9	89.6	0.1	0.8	-0.2	0.3	-2.2	2.1	-1.5	0.4
94.4	92.3	-0.6	1.1	-0.5	-0.3	-0.4	1.2	-0.5	0.4
94.4	93.6	-0.8	1.0	-0.8	-0.3	0.4	-0.2	0.8	-0.4
Ave Deviat		-0.5	-0.0	-0.6	0.3	0.1	0.1	-0.1	0.4
σ		0.7	0.9	0.6	0.7	1.1	1.0	0.7	0.6

The average deviation of the wet-dry bulb from the Ave Hygro reading is 0.4% RH with a standard deviation of 2.9% RH.

Table II. Humidity Sensor Calibration

3) Mean Temperature

Hewlett Packard Model 2801A. In this system the sensor is a quartz crystal which forms the capacitative element in an oscillator tank circuit. Temperature changes change the oscillator frequency, which is sensed for the temperature readout. This system is quite accurate, allowing temperatures to be determined within 0.03°C. Sea surface temperature is measured with the same system.

4) Mean Wind Speed

Thornthwaite Model 101 Wind Register System. This is a photoelectric system with very light plastic cups that allow measurement of winds as slight as one half knot.

5) Temperature Fluctuations

A low power ac Wheatstone bridge was constructed using a GTE Sylvania Inc. Model 140 Lightweight Thermo-sonde System with TSI Model 1210 probes with P.8 platinum wire used as the sensing elements. The low power bridge was operated at 100μAmp, the resistances of the probes were approximately 40 Ohms, thus, the energy dissipation in the sensor is 5×10^{-7} Watts. Very low power was used to insure that the sensor is not elevated above ambient temperature which prevents velocity fluctuations from influencing the wire response. The wire is 1.2 mm long and 2.5μ in diameter, and the probe has a time constant much shorter than the times encountered in atmospheric turbulence.

6) Wind Speed Fluctuations

TSI Model 1054B Anemometer, TSI Model 1210 probes with 6 mil. hot film elements were used as the sensing elements. An overheat ratio of 1.2 was utilized so that the wire temperature was approximately 150°C. The overheat greatly diminishes the influence of temperature fluctuations on these measurements.

The axes of the films were aligned in the vertical direction so that the wires were not sensitive to air flow in the vertical direction. Thus, only the horizontal component of wind speed fluctuations is detected.

7) Data Recording Equipment

Fluctuation data for temperature and wind speed were recorded on ¼ inch. magnetic tape.

Mean wind data was recorded by hand. The mean temperature and humidity were printed on paper tape with a Hewlett Packard 562AR printer.

In order to correctly understand the mean temperature data it is necessary to describe the data gathering sequence in some detail. There are five signals to record: humidity at two levels and temperature at three levels, including the sea surface. These signals are processed by a homemade sequencer which sorts and sends the signals to the printer. The sequencer steps cyclically from level to level in the sequence: sea surface → bow → mast, and the temperature and humidity at a given level are printed simultaneously. When the sequencer is at the sea surface step, zeros are printed for the humidity and this allows us to identify the levels on the print tape.

The interfacing between the sequencer and the Hewlett Packard temperature readout posed some problems. Since the readout is a frequency counter it has its own count cycle, the timing of which is set by a front panel control. It was not possible to control the readout timing by a command from the sequencer and we did not construct the sequencer to accept a command from the readout. Thus, it is possible for the sequencer to issue a print command when the counter is in a read cycle, leading to an error. We set the readout timer in a way so that such errors are very infrequent and they are normally easily identified.

The three mean temperatures and the two mean humidities were read and recorded every 2.5 minutes throughout the cruise except when a malfunction occurred. Fluctuation data was recorded at hourly intervals, as conditions warranted. The fluctuating signals were also continually processed by filtering and RMS units and recorded on strip chart units for real time averages of C_T and ε.

8) Acoustic Radar

An Aeroenvironment Model 300 acoustic radar was installed on the upper aft deck of the ship. The acoustic radar provides an information cross section of the lower atmosphere by emitting a brief pulse of sound upward (f = 1600 HZ), listening to the echoes which are reflected by temperature variations aloft, and displaying the height of the echoes on a chart. This device has been used successfully on shipboard in the Pacific to measure the height of the marine inversion up to 1km. No inversions were observed during the entire trip.

IV. MEAN DATA

1) Ship's Track

The approximate track of the ship is given in Figs. 2,3 and 4 based upon the planned track plus occasional notes made by the authors from the official navigator's charts. The ship's position at day (dd), month(mm)and GMT hour(hhhh) is indicated as mmdd-hhhh on the chart. This track is not intended to be an exact navigational record but is primarily to illustrate the rough position of the ship on various days. Presumably, the log kept by the ship's navigator will be made available by NRL in the near future.

2) Temperature and Humidity

Table 3 is a compilation of mean values of temperature and humidity obtained from the NPS equipment during the trip. Level 1 is the bow station, level 2 is the radar mast station and T_s is the sea "surface" temperature. Since the sea temperature sensor was between the hulls in a very turbulent region, it is assumed that it is more of a "bucket" temperature than an actual surface temperature.

V. TURBULENCE DATA

1) Definitions

The temperature structure function, C_T^2, is defined as

$$C_T^2 = < [T(x) - T(x+d)]^2 > d^{-2/3}$$

where T(x) is the temperature at position x and T(x+d) is the temperature at position x+d. In the inertial subrange of isotropic turbulence, C_T^2 is independent of d and can be related to the one dimensional power spectrum of temperature fluctuations, ϕ_T, by

$$\phi_T(k) = .25\, C_T^2\, k^{-5/3}$$

where k is the wave number. The parameter of optical interest is the index of refraction structure function, C_N^2, which is given approximately by (at sea level),

$$C_N^2 = (9.8 \times 10^{-7}\ {}^\circ C^{-1})^2\, C_T^2$$

The rate of dissipation of turbulent energy, ε, is related to the one dimensional power spectrum of velocity fluctuations, ϕ_u, by

$$\phi_u(k) = .5\, \varepsilon^{2/3}\, k^{-5/3}$$

in the inertial subrange. In the constant stress surface layer, the friction velocity, U_*, is related to ε by

$$\varepsilon KZ = U_*^3 f_\varepsilon(Z/L),$$

where K is von Karmon's constant = .35 and Z is the height above the surface. In near neutral conditions, $f_\varepsilon(Z/L) = 1$ and

$$U_* = (\varepsilon KZ)^{1/3}$$

The friction velocity is related to the mean velocity (u) profile by

$$\frac{\partial u}{\partial z} = \frac{U_*}{KZ} f_u (Z/L),$$

where $f_u(Z/L)$ is a stability correction. The eddy diffusivity, K_m, is given by

$$K_m = KZU_* f_u^{-1}(Z/L) .$$

2) Atlantic Crossing

Daily average values of C_T^2 and T are shown in Fig. 5 for the Atlantic Ocean crossing. This data illustrates the large values of C_T^2 found at the boundary of the warm waters of the Gulf stream around May 22.

3) Diurnal Variation of C_T^2

The diurnal variation of C_T^2 is of interest to optical propagation modelers as well as micrometeorologists. In general, the marine boundary layer is considerably less variable than its overland counterpart. We have divided the data into three separate goegraphical locations: the Atlantic coast of the U.S. and Canada (May 5-21), the warm waters of the Mid Atlantic (May 22-27) and the Mediterranean Sea (May 30 to June 6). Figure 6 is the bow level data (Z = 11 meters), Figure 7 is the radar mast level (Z = 20.5 meters) and Figure 8 shows both levels for all three regions combined.

4) Turbulence Data

Table 4 is a compilation of the fluctuation parameters C_T^2 and ε measured during the cruise. In addition, we have the friction velocity U_* which is related to the eddy diffusivity and ℓ_o, the microscale of turbulence. The atmospheric stability is given in terms of Richardson number, R_i.

$$R_i = \frac{g}{T} \frac{(\partial\theta_V/\partial Z)}{(\partial U/\partial Z)^2}$$

where g is the gravitational acceleration and θ_v is the virtual potential temperature.

Acknowledgements

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2. Lumley, J.L. and Panofsky, H.A., The Structure of Atmospheric Turbulence, New York, Interscience 1964.

TABLE III

Date	GMT	T_s	T_1	T_2	H_1	H_2	C_{T1}^2	C_{T2}^2	ε_1	ε_2	U_*	R_i
		°C			% RH		10^{-3} °$C^2/m^{2/3}$		10^{-3} m^2/sec^3		m/sec	
05157	1200	11.63	12.45	12.53	60	61	2.10	1.48				
05157	1230	11.46	12.29	12.45	62	63	2.10	1.48				
05157	1300	12.12	12.38	12.47	63	64	2.22	1.89				
05157	1300	11.65	12.21	12.39	62	63						
05157	1330	12.12	12.38	12.47	63	64	3.03	1.89	5.0	2.0	.25	.
05157	1400	11.73	12.41	12.50	63	65	2.10	1.48	5.0	1.7	.25	.
05157	1430	11.49	12.34	12.44	62	64	1.89	1.48	4.400	1.7	.24	.
05157	1500	11.88	12.18	12.36	62	63	3.08	1.89	4.4	1.7	.24	
05157	1530	11.87	12.01	12.19	63	65	3.08	1.89	4.4	1.5	.24	.
05157	1600	11.98	11.96	12.22	63	65	3.08	1.69	3.3	1.3	.21	.
05157	1630	11.18	11.80	11.97	65	66	2.10	1.23	3.5	1.3	.22	.
05157	1700	11.95	11.90	11.97	62	64	2.82	1.69	3.3	1.1	.21	.
05157	1730	11.84	.	.			.	.	.	.	.	.
05157	1800	11.79	.	.			.	.	.	.	.	.
05157	1830	11.87	11.96	11.88	60	62	5.20	2.00	.95	.48	.15	
05157	1900	11.78	12.12	12.16	56	57	5.61	2.82	.47	.34	.13	.
05157	1930	11.91	12.43	12.70	54	55	4.91	2.10	.47	.	.	.
05157	2000	12.12	12.83	13.10	55	56	6.35	3.22	.14	.04	.07	.
05157	2030	12.52	12.56	12.65	48	43	5.20	.	.14	.10	.09	.
05157	2100	12.52	13.31	13.43	55	46	8.21	3.73	.085	.070	.07	
05157	2130	11.79	13.18	13.32	62	55	3.79	4.10	.085	.080	.07	-.05
05157	2200	11.10	12.77	13.46	60	65	5.20	7.56	.	.	.	.
05157	2230	11.27	12.64	13.48	58	60	2.57	3.36	2.2	1.5	.21	.
05157	2300	12.37	12.67	12.00								
05157	2300	12.37	12.67	12.00								
05157	2330	11.36	11.83	12.41			.	.	.	.	.	.
05157	2400	10.49	11.89	12.08	63	62	2.45	3.94	4.5	1.9	.25	.
05167	0100	9.50	11.38	11.50	63	64	1.31	.	.	.	.	.
05167	0130	10.15	11.30	11.41	67	66	1.31	.	.	.	.	.
05167	0200	10.29	11.18	11.37	69	66	1.31	.	.	.	.	.
05167	0230	9.48	11.10	11.21	69	67	1.46	.	.	.	.	.
05167	0300	10.12	10.86	11.14	71	76						
05167	0330	9.84	10.96	11.35	69	64						
05167	0400	9.41	10.79	11.01	70	66						
05167	0430	9.77	10.60	10.69	73	71						
05167	0500	9.59	10.48	10.56	75	74						
05167	0530	9.94	10.37	10.44	77	75						
05167	0600	9.42	10.33	10.38	76	74						
05167	0630	9.21	10.05	10.14	77	75						
05167	0700	9.10	9.90	9.99	79	77						
05167	0730	9.37	10.17	10.27	78	00						
05167	0800	10.18	10.56	10.61	75	74						
05167	0830	09.65	10.74	11.04	73	68						
05167	0900	9.97	11.03	11.87	68	62						
05167	0930	9.62	10.84	11.51	65	64						
05167	1000	10.56	11.50	11.45	67	63						
05167	1030	9.77	11.59	11.60	66	65						
05167	1100	9.64	11.61	11.60	65	67						
05167	1130	10.15	11.78	11.70	66	68						
05167	1200	9.65	11.68	00.00	66	68						
05167	1230	9.40	11.42	11.84	67	66						
05167	1300	9.43	11.31	11.78	69	70						
05167	1330	9.96	11.30	11.71	71	70						
05167	1400	10.58	12.35	12.07	67	64						
05167	1430	9.42	12.79	10.02	62	62						
05167	1500	00.00	12.22	12.44	63	00						
05167	1530	00.00	11.73	11.98	67	62						
05167	1600	00.00	10.46	10.92	71	66						
05167	1630	.	10.07	10.47	74	70	1.38	.	14.7	.	.31	.
05167	1700	.	10.24	10.57	74	71	2.21					
05167	1730	00.00	10.06	10.05	74	72						
05167	1800	7.56	10.51	11.08	73	70						
05167	1830	7.04	11.00	10.94	67	67						
05167	1900	7.53	10.58	10.65	69	69						
05167	1930	7.09	11.01	10.58	68	70						
05167	2000	6.58	10.02	10.58	69	71						
05167	2030	6.48	10.36	10.02	68	72						
05167	2100	8.20	10.99	10.43	69	74						

05167	2130	8.59	10.99	10.69	71	73						
05167	2200	8.38	10.91	13.63	72	72						
05167	2230	8.49	10.94	10.87	73	70						
05167	2300	8.52	10.72	10.37	74	77						
05167	2330	8.41	10.11	10.52	76	76						
05167	2400	8.59	9.89	10.63	80	75						
05177	1436	4.85	8.07	8.63	79	76	04.00	12.20	27.5	.	.48	.05
05177	1445	4.59	8.10	8.77	72	77	3.64	12.2	25.	12.	.44	.06
05177	1455	4.57	7.96	8.57	79	77	3.64	.	26.	11.5	.44	.06
05177	1505	4.60	7.92	8.57	79	78	.	.	26.	11.5	.44	.06
05177	1530	4.86	7.95	9.59	80	92						
05177	1600	4.64	7.57	9.51	79	68						
05177	1630	4.84	7.59	8.33	79	74						
05177	1700	4.77	7.56	8.17	79	76						
05177	1730	4.97	7.74	8.19	77	75						
05177	1800	5.10	7.77	8.01	76	75						
05177	1830	4.87	7.79	8.08	76	75						
05177	1900	4.08	7.34	7.75	74	74						
05177	1930	4.49	7.64	8.11	74	73						
05177	2000	4.56	7.68	7.66	73	73						
05177	2005						3.25	10.9	25.5	15.5	.47	.05
05177	2015						3.79	11.9	27.5	15.5	.47	.05
05177	2030	4.06	8.01	7.92	72	74	4.41	11.7	30.5	21.	.50	.05
05177	2040						4.11	14.50	33.	17.	.45	.05
05177	2050						4.41	15.8	30.5	14.	.47	.
05177	2100	4.42	7.96	7.96	73	74	4.42	15.8	33.	14.	.48	.
05177	2130	4.53	8.08	9.84	73	74						
05177	2200	4.21	7.72	8.61	73	71						
05177	2230	3.36	6.68	7.71	76	74						
05177	2300	3.38	6.81	8.57	79	77						
05177	2330	3.01	6.72	10.75	36	66						
05177	2400	2.62	6.71	12.25	78	64						
05187	1130	2.96	5.14	5.44	90	86	7.31	6.16	15.5	4.35	.35	.07
05187	1200	2.60	4.97	5.34	77	76	6.96	8.27	15.5	4.10	.35	.06
05187	1230	2.42	5.42	5.98	78	74	9.40	9.93	9.5	2.15	.27	.08
05187	1300	2.69	5.92	6.35	73	70	10.2	10.7	8.5	1.7	.27	.
05187	1330	2.71	6.67	6.94	99	74	7.17	7.60	3.6	1.85	.24	.11
05187	1400	2.61	6.40	0.00	63	64						
05187	1430	2.71	6.87	7.53	60	61	7.33	5.21	2.9	.95	.21	.11
05187	1500	2.64	5.51	6.38	68	00	4.86	4.20	4.3	1.900	.25	.
05187	1530	3.34	5.15	5.83	61	61						
05187	1600	3.83	5.06	5.20	58	58	.97	.97	.95	2.6	.21	.11
05187	1630	3.73	3.85	4.59	60	59	.	.	.	.	.	.
05187	1700	4.13	3.25	4.26	62	62	.	.	.	.	.	.
05187	1730	3.39	0.00	4.18	65	64	.90	.50	.75	.10	.14	.
05187	1800	3.20	4.04	4.03	67	66	.66	.74	1.6	1.1	.19	.05
05187	1830	3.62	4.17	3.64	63	63	.66	.46	.90	.55	.15	.
05187	1900	3.50	4.16	3.87	60	62	.	.	.	.	.	.
05187	1930	3.10	3.86	3.54	61	64	.18	.23	.90	.90	.17	.09
05187	2000	2.80	3.87	3.54	62	65	.30	.30	8.000	8.000	.34	.03
05187	2030	2.59	3.92	3.54	61	64	.36	.29	26.5	9.5	.43	.02
05187	2100	2.43	3.98	3.49	61	64	.29	.44	26.	9.0	.43	.03
05187	2130	2.25	4.04	3.59	60	63	.32	.46	20.5	9.000	.41	.03
05187	2200	2.31	4.12	3.76	60	62	.51	.63	22.5	7.5	.40	.
05187	2230	2.46	3.94	3.82	60	62	.81	.82	20.5	7.5	.40	.
05187	2300	2.59	3.18	3.19	69	69	.37	.37	18.	5.5	.35	.02
05187	2330	2.67	3.10	3.12	71	71	.39	.35	14.5	6.0	.37	.01
05187	2400	2.55	3.05	3.06	73	72	.37	.29	14.5	6.0	.37	.01
05197	0030	2.39	2.80	2.79	78	78	.22	.16	9.5	4.3	.32	.01
05197	0100	2.60	2.83	2.80	80	79	.31	.25	9.0	4.2	.32	.00
05197	0130	2.49	2.79	2.76	80	79	.29	.22	8.0	3.1	.29	.00
05197	0200	2.42	2.69	2.62	83	82	.16	.16	3.8	3.0	.26	.01
05197	0230	2.31	2.61	0.00	85	83						
05197	0300	3.29	2.84	2.73	86	84						
05197	0330	3.18	2.98	2.89	85	84						
05197	0400	2.28	2.88	2.84	86	84						
05197	0430	3.36	3.03	2.94	87	86						
05197	0500	3.09	2.98	2.93	88	87						
05197	0530	3.09	3.02	2.95	88	89						
05197	0600	3.35	3.09	2.98	90	89						
05197	0630	2.97	3.10	3.03	CC	90						
05197	0700	3.09	3.07	3.04	92	91						
05197	0730	3.38	3.25	3.18	92	91						
05197	0800	3.16	3.31	3.29	91	90						

05197	0830	3.21	3.51	3.35	92	90						
05197	0900	3.02	3.74	3.82	88	87						
05197	0930	3.17	4.05	4.40	82	82	.	00.07	2.7	.	.21	.08
05197	1000	3.18	3.44	4.32	80	79	.	.12	3.0	1.85	.23	.
05197	1030	3.22	3.98	3.90	78	78	.	.12	3.3	2.2	.24	.06
05197	1100	3.03	3.97	3.87	78	79	.	.	.	.	.	.
05197	1130	2.86	4.12	3.84	78	79	00.05	00.09	2.6	1.65	.21	.07
05197	1200	2.78	4.05	3.72	78	79	.03	.03	2.3	1.55	.21	.
05197	1230	2.90	3.88	3.49	80	81	.06	.04	1.95	1.3	.20	.07
05197	1300	2.96	3.77	3.45	79	80	.16	.09	1.700	1.05	.18	.08
05197	1330	2.95	3.73	3.56	79	79	.10	.09	1.0	.8	.17	.11
05197	1400	3.19	3.74	3.60	78	78						
05197	1430	3.26	3.72	3.71	77	77	.58	.38	.65	.1	.14	.05
05197	1500	3.63	3.73	3.75	84	76	.76	.51	.49	.34	.13	.07
05197	1530	3.99	3.67	3.76	78	77	.87	.58	.	.	.	.
05197	1600	4.31	3.81	3.94	77	76	1.09	.58	.41	.18	.11	.
05197	1630	4.31	4.01	4.10	77	76	1.23	.62	.47	.20	.12	-.10
05197	1700	2.85	2.38	3.89	80	79	.39	.28	.600	.37	.13	.06
05197	1730	3.25	3.65	3.69	83	82	.19	.16	1.6	.16	.17	.06
05197	1800	3.13	3.57	3.49	84	83	.27	.31	1.05	.60	.16	.05
05197	1830	3.02	3.65	3.42	85	84	.	.	.85	.60	.15	.06
05197	1900	2.68	3.56	3.23	84	85	.	.	.	.	.	.
05197	1930	3.00	3.52	3.25	83	83	.05	.04	.85	.60	.15	.09
05197	2000	2.76	0.00	3.47	83	82						
05197	2030	3.15	3.33	3.46	84	80						
05197	2100	3.31	3.23	3.28	84	81	.35	.24	.21	.19	.10	-.03
05197	2130	3.39	3.15	3.12	81	80	.51	.28	.27	.130	.09	.
05197	2200	3.04	2.90	2.73	84	82	.14	.10	.11	.11	.08	.00
05217	2230	13.68	11.32	11.21	74	74						
05197	2300	2.82	2.98	2.88	86	86	.10	.08	.09	.	.07	.04
05217	2330	13.62	10.91	10.72	65	67						
05197	2330	3.39	3.06	2.94	84	84	.44	.79	.10	.	.07	.
05197	2400	3.28	3.08	2.98	84	83	.43	.24	.15	.	.09	.
05207	0030	3.27	3.15	3.04	80	80	.76	.38	.18	.37	.11	-.16
05207	0100	3.33	3.16	3.06	78	78	.87	.44	.44	.17	.11	-.10
05207	0130	3.45	3.15	3.04	78	78	1.28	.66	.18	.27	.10	-.20
05207	0200	3.24	3.07	2.98	73	73	1.4	.62	.39	.20	.11	-.14
05207	0230	3.80	2.95	2.83	72	73	1.49	.55	.48	.19	.13	-.32
05207	0300	3.70	2.80	2.64	77	78	1.05	.44	.44	.26	.12	-.35
05207	0300	3.61	2.61	2.50	79	79						
05207	0400	3.57	2.48	2.36	76	77						
05207	0430	2.29	2.17	3.48	79	79						
05207	0500	2.58	2.45	3.45	80	81						
05207	0530	3.49	2.50	2.39	76	77						
05207	0600	3.34	0.00	0.00	00	75						
05207	0630	3.49	2.46	2.33	75	76						
05207	0700	3.78	2.41	2.26	77	77						
05207	0730	3.86	2.03	1.89	80	80						
05207	0800	3.93	1.74	1.60	82	82						
05207	0830	3.79	1.52	1.36	84	84						
05207	0900	3.75	1.29	1.14	87	87	1.79	.79	2.9	1.9	.23	.
05207	0930	3.94	0.82	0.67	89	90	2.74	1.12	3.2	2.9	.25	-.29
05207	1000	3.91	0.87	0.72	91	92	3.87	1.79	3.8	2.8	.17	-.28
05207	1030	3.30	0.68	0.52	92	92	3.43	2.61	4.1	2.9	.25	-.26
05207	1100	2.99	1.21	1.03	92	93	2.48	2.24	4.1	2.7	.25	-.17
05207	1130	3.02	1.73	1.58	90	92	1.79	2.23	4.2	2.9	.26	-.12
05207	1200	3.11	2.23	2.06	86	88	1.4	1.21	2.8	1.7	.22	-.10
05207	1230	3.02	2.46	2.33	86	87	.89	.44	1.7	1.2	.19	-.07
05207	1300	3.03	1.63	2.26	88	89	.87	.47	1.7	.95	.18	-.04
05207	1330	2.47	2.11	2.07	90	90						
05207	1400	2.15	2.11	2.07	93	95						
05207	1430	2.03	2.80	1.30	92	92						
05207	1500	0.00	0.00	0.00	00	00						
05207	1530	.	.	.								
05207	1600	3.46	4.04	4.44	84	84						
05207	1630	5.27	4.73	4.97	79	79						
05207	1700	5.91	5.15	5.36	78	78	1.12	.64	1.3	.80	.17	-.03
05207	1730	6.08	5.57	3.04	77	77	1.49	.92	1.4	.90	.17	-.10
05207	1800	6.38	6.05	6.04	77	78	1.39	.87	1.4	.75	.17	-.07
05207	1830	6.65	1.92	5.95	78	79	1.22	.78	1.7	.85	.18	.
05207	1900	6.39	6.20	6.00	77	79	1.49	1.09	3.3	2.1	.23	.
05207	1930	6.61	6.20	6.06	76	78	1.4	1.0	4.5	2.3	.25	-.06
05207	2000	6.67	6.23	6.01	79	80	.	.	.	.	.	.
05207	2030	6.67	6.00	5.80	81	83	1.9	2.24	1.3	2.0	.24	-.06

05207	2100	6.64	5.86	5.60	84	85	2.0	2.0	3.2	1.8	.23	-.07
05207	2130	6.76	5.93	5.65	87	88	1.59	1.90	3.9	2.2	.25	.
05207	2200	6.43	5.86	5.65	89	90	1.4	1.59	8.0	3.3	.30	-.11
05207	2230	6.52	5.94	5.70	91	91	1.22	1.30	7.5	4.0	.30	.
05207	2300	6.42	6.29	6.13	92	92	1.49	.32	5.5	2.9	.27	.
05207	2330	6.22	6.39	6.25	92	92	.	.16	4.3	2.8	.26	.00
05207	2400	6.15	6.53	6.39	92	92	.	.10	4.3	2.8	.26	.
05217	0030	6.85	6.76	6.62	93	93	.10	.18	4.3	2.9	.26	-.01
05217	0100	7.00	7.10	6.93	94	94	.04	.05	4.6	3.0	.27	.00
05217	0130	7.11	7.46	7.37	93	93	.05	.07	4.7	2.8	.26	-.02
05217	0200	7.55	7.74	7.66	92	92	.16	.24	3.6	2.4	.25	.01
05217	0230	7.68	7.88	7.79	91	91	.13	.20	3.0	2.0	.23	.01
05217	0300	7.59	7.99	7.89	90	90	.08	.09	3.4	02.4	.25	.02
05217	0330	7.49	8.06	7.96	90	90						
05217	0400	8.09	8.23	8.10	93	92						
05217	0430	9.59	8.43	8.28	92	92						
05217	0500	8.43	8.29	8.17	97	93						
05217	0530	7.55	8.11	8.05	95	95						
05217	0600	6.25	8.36	8.32	96	95						
05217	0630	3.66	8.46	8.46	95	94						
05217	0700	4.06	8.46	8.49	96	94						
05217	0730	8.02	8.56	8.61	96	94						
05217	0800	8.17	8.68	8.73	96	95						
05217	0830	8.39	8.83	8.85	97	95						
05217	0900	8.49	9.04	9.05	97	96						
05217	0930	8.21	9.20	9.24	98	96						
05217	1000	12.00	11.25	10.98	96	98						
05217	1030	14.08	11.83	11.68	98	96						
05217	1100	15.86	12.17	11.95	96	93						
05217	1130	15.57	9.57	11.91	94	91						
05217	1200	16.15	12.22	11.93	91	89						
05217	1230	15.42	11.88	11.87	90	89						
05217	1300	14.52	10.78	12.20	85	83						
05217	1330	14.55	12.20	12.03	84	83						
05217	1400	15.84	12.21	11.91	85	87						
05217	1430	15.82	11.87	11.65	89	68						
05217	1500	15.45	11.71	11.70	85	87						
05217	1530	15.34	12.43	12.23	84	81						
05217	1600	15.40	12.26	12.13	83	81						
05217	1630	15.57	12.38	12.25	82	79						
05217	1700	14.19	12.38	12.40	74	77						
05217	1730	14.02	12.13	12.37	80	77						
05217	1800	14.41	12.24	12.51	81	79						
05217	1830	14.38	12.09	12.25	80	77						
05217	1900	14.42	11.29	11.20	83	81						
05217	1930	14.58	10.71	10.56	91	90						
05217	2000	14.56	11.05	10.77	91	90						
05217	2030	14.54	11.09	10.90	86	85						
05217	2100	14.57	11.28	11.03	82	81						
05217	2130	14.69	11.19	11.01	78	78						
05217	2200	14.57	11.42	11.18	75	74						
05217	2230	13.68	11.32	11.21	74	74						
05217	2300	13.63	11.33	11.20	71	71						
05217	2330	13.62	10.91	10.49	63	64						
05217	2400	13.61	10.68	10.49	63	64						
05227	1730	14.41	11.06	10.92	43	42	16.7	6.2	8.0	4.2	.31	-.15
05227	1800	14.52	00.00	11.05	45	44	26.4	10.6	18.	5.0	.37	.
05227	1815						21.3	7.8	14.	6.	.36	.
05227	1830	14.64	12.59	10.53	56	53	.	.	.	.	.	.
05227	1900	14.58	10.45	10.34	58	58						
05227	1930	.	10.57	10.66	58	60						
05227	2000	13.12	11.33	11.22	57	52						
05227	2030	15.20	10.99	10.89	54	51						
05227	2100	.	11.18	11.24	54	56						
05227	2130	.	.	.								
05227	2200	15.48	11.20	11.28	44	43						
05227	2230	15.63	11.20	11.04	46	44						
05227	2300	15.64	11.36	11.19	47	45						
05227	2330	15.62	11.24	.	44	43						
05227	2400	15.56	00.00	11.16	44	43						
05237	0800	15.82	12.07	11.95	47	45	13.8	4.0	1.3	.	.17	.
05237	0830	16.17	12.24	12.14	51	49	11.4	5.0	1.7	.	.19	.
05237	0900	16.51	12.35	12.26	48	47	8.83	3.95	1.7	.	.19	1.43
05237	0930	16.24	12.54	12.45	44	43	10.8	4.18	1.5	1.0	.18	-1.31

05237	1000	15.72	13.16	13.04	42	42	8.64	3.62	.	.	.	.
05237	1030	15.06	13 07	12 96	44	43	1.02	3.95	2.4	1.8	.21	-.62
05237	1100	16.08	C0.00	13.04	44	43						
05237	1130	15.88	13.16	13.09	43	42	1.38	5.05	.	.	.	.
05237	1200	15.95	12.91	12.91	46	44	11.9	3.78	1.1	.8	.16	-1.49
05237	1230	15.88	12.99	13.99	47	45	10.8	4.18	1.4	.85	.17	-1.04
05237	1300	16.12	13.00	13.00	50	48	.	.	.	.	.	.
05237	1330	16.10	13.10	13.27	49	46	13.5	5.25	1.5	.9	.18	-1.01
05237	1400	16.18	13.09	13.27	51	48	12.9	4.30	1.200	.65	.17	-1.25
05237	1430	16.12	13.49	13.47	55	53	13.8	4.67	1.6	.80	.18	-.95
05237	1500	00.00	00.00	00.00	00	00	.	.	.	.	.	.
05237	1530	00.00	C0.00	00.00	CC	00	.	.	.	.	.	.
05237	1600	16.13	13.47	13.48	65	70	.	.	.	.	.	.
05237	1630	15.94	13.37	13.45	63	65	13.4	5.86	1.8	1.1	.19	-.86
05237	1700	15.92	13.43	14.47	67	66	12.5	6.51	2.2	.95	.25	-.77
05237	1730	15.88	13.47	13.47	71	71	12.6	6.07	3.3	1.4	.22	-.56
05237	1800	15.82	13.48	13.45	76	76	11.4	5.9	3.4	1.6	.22	-.24
05237	1830	15.86	13.34	13.35	82	81	10.5	4.9	3.4	1.1	.21	-.26
05237	1900	16.02	13.42	13.43	86	85	10.2	4.67	3.9	1.5	.23	-.19
05237	1830	14.64	12.59	10.53	56	53	10.2	4.67	3.9	1.5	.23	-.19
05237	1930	16.06	13.57	13.56	86	85	8.9	4.3	3.4	1.4	.22	.
05237	2000	16.04	13.66	13.62	87	86	8.1	4.3	5.0	1.8	.25	.
05237	2030	16.22	13.90	13.80	88	88	8.1	4.3	3.8	2.0	.24	.
05237	2100	16.40	13.99	13.81	89	89	8.1	4.3	2.8	1.8	.22	.
05237	2130	16.56	14.22	14.06	89	90	7.0	3.6	1.8	1.6	.21	-.22
05237	2200	16.78	10.38	14.24	89	88						
05237	2230	16.83	14.64	14.57	88	88						
05237	2300	17.03	14.76	14.64	87	87						
05237	2330	17.04	14.98	14.87	87	86						
05237	2400	14.24	15.17	15.29	87	87						
05247	1900	17.04	17.16	17.06	86	86	.15	.15	1.8	1.2	.19	-.01
05247	1930	17.17	17.07	16.99	86	86	.30	.27	1.6	1.2	.19	.
05247	2000	16.98	17.09	17.01	85	85	.36	.36	1.4	.8	.17	-.02
05247	2030	17.14	17.14	17.07	85	84	.61	.44	1.0	.65	.16	-.03
05247	2100	17.17	17.00	16.99	85	85	.70	.51	1.0	.55	.16	-.05
05247	2130	16.90	16.84	16.75	86	86	.65	.53	.75	.55	.15	-.04
05247	2200	16.61	16.72	16.64	86	86	.55	.45	.90	.60	.15	-.02
05247	2230	17.47	17.10	17.02	84	83	1.7	1.1	1.4	.85	.17	-.07
05247	2300	17.46	17.10	17.00	82	82	1.63	1.26	1.6	.80	.18	-.07
05247	2330	17.40	17.10	17.01	72	78						
05247	2400	17.17	17.10	17.04	19	79	2.01	1.20	2.4	1.6	.21	-.03
05257	0030	17.19	17.14	17.06	80	79	1.36	.98	2.80	1.5	.21	-.03
05257	0100	17.27	17.11	17.05	79	78	1.46	.93	3.3	2.0	.24	-.03
05257	0130	17.38	17.15	17.10	77	76	2.25	1.23	3.7	2.0	.24	-.04
05257	0200	17.38	17.11	17.05	77	76	2.25	1.38	3.5	1.8	.23	-.04
05257	0230	17.25	17.09	17.03	78	77	2.25	1.43	3.2	1.9	.23	-.03
05257	0300	17.20	16.97	15.88	79	77	2.01	1.38	3.2	1.9	.23	.04
05257	0330	17.60	17.00	16.94	76	75						
05257	0400	17.34	16.94	16.89	77	76						
05257	0430	17.74	16.95	16.86	78	77						
05257	0500	17.62	16.90	16.81	78	78						
05257	0530	17.05	16.63	16.52	CC	80						
05257	0600	17.03	16.43	16.36	82	81						
05257	0630	16.84	16.41	16.38	81	80	2.51	2.25	4.5	2.7	.26	.22
05257	0700	16.45	16.51	16.67	80	77	2.51	2.51	4.5	2.7	.26	.22
05257	0730	16.46	16.71	16.88	78	75	2.25	2.01	5.2	2.8	.27	.22
05257	0800	16.51	16.89	17.04	78	75	2.51	2.13	4.7	2.0	.26	.20
05257	0830	16.47	16.79	16.78	78	75	2.51	2.13	4.7	3.4	.27	.
05257	0900	16.49	17.00	17.02	77	75	2.38	2.01	3.7	3.3	.27	.06
05257	0930	16.11	16.68	16.71	78	75	1.89	1.89	5.6	3.6	.29	.05
05257	1000	16.10	16.63	16.62	78	75	2.01	1.78	5.2	3.8	.29	.03
05257	1030	16.41	16.70	16.56	77	75	.	.	.	.	.	.
05257	1100	16.19	16.54	16.49	77	75	2.57	1.56	4.5	3.2	.27	.00
05257	1130	16.08	16.61	16.46	77	75	2.51	1.78	3.9	2.2	.25	.00
05257	1200	16.03	16.59	16.41	76	74	2.64	2.01	3.3	.60	.24	.00
05257	1230	16.09	16.56	16.42	74	73	2.64	2.01	3.5	.	.24	.00
05257	1300	16.37	16.58	16.46	75	75	.	.	.	.	.	.
05257	1330	16.19	16.69	16.60	75	74	2.78	2.25	3.4	.	.24	.00
05257	1400	16.28	16.75	16.73	72	72	2.64	2.38	3.4	2.3	.24	.00
05257	1430	16.60	16.77	16.75	74	74	3.07	2.25	3.1	1.9	.23	-.01
05257	1500	16.62	16.90	16.87	75	74	3.07	2.01	3.0	1.9	.23	-.01
05257	1530	17.15	17.12	17.07	76	74	3.37	2.51	3.6	2.2	.23	-.03
05257	1600	17.08	16.99	16.91	76	74	3.67	2.51	3.6	2.3	.25	-.03
05257	1630	17.27	16.71	16.67	77	76	.	.	.	.	.	.

05257	1700	17.34	16.36	16.28	76	76	.	.	.	.	.	.
05257	1730	17.57	16.85	16.83	75	74	5.14	3.00	2.4	1.6	.30	-.07
05257	1800	17.67	17.08	17.00	71	71	.	.	.	.	.	.
05257	1830	17.71	17.12	16.54	68	68	.	.	.	.	.	.
05257	1900	.	16.93	16.83	72	71	.	.	.	.	.	.
05257	1930	17.41	16.80	16.69	73	72	.	.	.	.	.	.
05257	2000	17.30	16.66	16.58	73	72	5.71	3.14	2.1	1.4	.20	.
05257	2030	17.21	16.60	16.49	73	73	5.14	2.72	1.6	1.2	.19	-.09
03257	2100	16.89	16.58	16.49	72	72	4.77	2.58	1.3	.85	.17	-.07
05257	2130	16.83	16.58	16.49	72	72	5.14	2.45	1.2	.70	.17	-.07
05257	2200	16.76	16.52	16.45	74	74	4.25	2.20	1.3	.70	.17	-.07
05257	2230	16.68	16.43	16.31	77	76	3.91	2.20	1.2	.80	.17	-.07
05257	2300	.	.	.			.	.	.	.	.	.
05257	2330	16.53	16.32	16.21	77	76	4.08	1.74	1.3	1.8	.17	-.10
05257	2400	16.55	16.26	16.15	77	77	3.75	1.74	1.1	.80	.17	-.07
05267	0030	16.60	16.24	16.14	76	76	4.42	2.08	1.2	.80	.17	-.08
05267	0100	16.46	16.19	16.07	78	78	3.91	1.96	1.6	1.2	.19	-.07
05267	0130	16.00	16.07	15.97	78	77	3.44	1.53	1.4	1.0	.18	-.03
05267	0200	15.94	16.02	15.93	72	77	4.59	1.96	1.0	.8	.17	-.04
05267	0230	16.22	16.11	16.01	76	75	5.32	2.32	1.5	.8	.17	-.06
05267	0300	16.24	16.12	16.01	76	75	4.95	2.2	1.4	.8	.17	-.05
05267	0330	16.42	16.08	15.97	78	77						
05267	0400	16.34	16.00	15.88	78	77						
05267	0430	16.33	15.87	15.77	78	78						
05267	0500	16.10	15.81	15.73	77	68						
05067	0530	16.06	15.72	15.61	78	78						
05267	0600	16.18	15.69	15.60	77	77						
05267	0630	16.10	15.80	15.79	76	76						
05267	0700	15.93	15.84	15.84	79	78	2.45	.	.49	.18	.12	-.07
05267	0730	15.79	15.90	15.85	77	77	2.45	.	.36	.16	.11	-.06
05267	0800	15.84	15.82	15.74	78	78	2.71	.	.10	.16	.08	.
05267	0830	15.76	16.26	16.14	75	76						
05267	0900	15.89	16.24	16.07	75	73						
05267	0930	15.74	16.04	15.88	76	77						
05267	1000	16.22	16.20	16.31	74	73						
05267	1030	16.27	16.32	16.89	74	74						
05267	1100	17.09	16.33	16.71	73	72						
05267	1130	16.71	16.31	16.68	74	72						
05267	1200	16.70	16.29	16.48								
05267	1230	16.75	16.28	.	77	75						
05267	1300	.	.	.								
05267	1330											
05267	1400	16.80	16.52	16.56	74	73						
05267	1430	16.90	16.51	16.60	73	73	1.11	.64	.29	.24	.11	-.21
05267	1500	17.10	16.57	16.71	73	72	1.22	.74	.27	.19	.10	-.29
05267	1530	17.54	16.60	16.82	72	71	1.66	.79	.32	.22	.11	-.47
05267	1600	16.88	16.64	16.85	70	70	1.24	.72	.25	.20	.10	-.26
05267	1630	17.38	16.79	16.92	68	67	1.53	.93	.29	.22	.11	-.41
05267	1700	17.32	16.84	16.69	68	69	1.43	.86	.31	.24	.11	-.38
05267	1730	17.57	16.84	16.94	65	65	1.43	1.04	.36	.26	.11	-.28
05267	1800	17.27	16.90	16.98	62	63	1.63	1.06	.34	.25	.11	-.26
05267	1830	16.93	16.60	16.87	68	66	1.74	.75	.38	.27	.12	.
05267	1900	17.57	16.45	16.67	69	67	1.15	.98	.32	.24	.11	.
05267	1930	17.69	16.43	16.42	68	69	2.32	.90	.44	.30	.12	-.32
05267	2000	.	16.40	16.32	67	68	2.71	1.34	.58	.41	.13	-.18
05267	2030	17.38	16.40	16.31	68	69	1.96	1.52	.50	.35	.13	-.25
05267	2100	17.57	18.41	16.30	71	71	2.20	1.74	.65	.35	.13	-.25
05267	2130	17.52	16.44	16.31	71	71	2.20	1.85	.75	.44	.14	-.15
05267	2200	16.64	16.31	16.20	72	72	2.45	1.74	.70	.36	.13	-.12
05267	2230	16.46	16.26	16.17	74	74	1.35	1.42	.85	.20	.14	-.12
05267	2300	17.36	10.42	16.11	73	73	2.08	1.74	.85	.45	.14	-.18
05267	2330	16.96	16.34	16.03	73	73	2.20	1.62	.90	.41	.14	.
05267	2400	16.97	16.16	16.05	72	72	2.45	1.96	1.1	.47	.15	-.16
05277	0030	16.61	16.10	16.00	73	73	2.86	2.08	1.4	.65	.17	-.11
05277	0100	16.67	16.02	15.92	73	73	3.29	2.45	1.6	.85	.18	-.10
05277	0130	16.60	15.98	15.89	74	74	3.14	2.20	2.0	1.0	.19	-.08
05277	0200	16.59	15.63	15.54	78	78	2.45	1.74	1.0	.6	.16	-.16
05277	0230	16.32	15.48	15.38	78	78	2.20	1.85	.9	.5	.15	-.16
05277	0300	15.84	15.29	15.21	80	79	1.96	1.53	.20	.55	.15	-.11
05277	0330	16.54	15.25	15.17	80	80						
05277	0400	16.40	15.24	15.16	78	77						
05277	0430	16.36	15.10	15.04	78	77						
05277	0500	16.45	15.07	14.99	79	78						
05277	0530	18.40	15.09	15.04	75	74	5.91	3.56	6.0	2.8	.27	-.07

05277	0600	17.01	15.12	15.06	76	74	6.11	4.08	7.5	3.1	.29	-.09
05277	0630	17.40	15.11	15.05	74	73	6.96	4.08	9.0	3.0	.30	-.09
05277	0700	17.04	15.19	15.19	74	73	7.18	4.42	8.5	5.5	.32	-.08
05277	0730	16.40	15.14	15.19	75	73	5.52	4.25	10.	.	.34	-.05
05277	0800	15.67	15.22	15.23	74	73	5.71	4.08	11.	.	.35	-.10
05277	0830	18.00	15.40	15.28	74	72	.	.	.	.	.	.
05277	0900	15.87	15.31	15.21	75	74	.	.	.	.	.	.
05277	0930	15.67	15.28	15.46	74	74	4.42	3.44	18.	6.0	.37	-.10
05277	1000	15.63	15.14	15.30	75	74	3.91	3.29	14.	6.0	.36	-.12
05277	1030	15.80	15.18	15.32	76	75	4.24	3.59	15.	6.5	.37	.
05277	1100	15.61	15.17	15.35	77	76	3.91	3.00	15.	6.5	.37	-.10
05277	1130	15.66	15.28	15.18	78	78	.	.	.	.	.	.
05277	1200	15.51	15.27	15.12	77	77	3.29	2.86	16.	8.0	.39	-.07
05277	1230	15.58	15.51	15.14	78	77	3.00	3.29	15.	7.0	.37	-.07
05277	1300	15.75	15.34	15.17	77	78	.	.	.	.	.	.
05277	1330	15.58	15.32	15.16	78	79	2.58	2.72	20.	11.	.42	-.06
05277	1400	15.65	15.35	15.34	78	78						
05277	1430	15.39	15.35	15.42	78	78						
05307	1930	19.40	17.53	17.39	70	70						
05307	2000	19.39	17.49	17.36	74	74						
05307	2030	18.02	17.44	17.25	73	74	1.93	3.93	5.0	2.4	.26	.
05307	2100	17.83	17.36	17.22	72	72	2.23	3.29	6.0	3.4	.29	.
05307	2130	17.51	16.97	16.87	72	72						
05307	2200	16.94	16.75	16.65	73	73						
05307	2230	16.97	16.62	16.52	74	74						
05307	2300	16.96	16.56	16.46	74	74						
05307	2330	16.61	16.46	16.35	75	75						
06017	2400	18.82	17.90	17.75	83	83						
05317	0830						10.4	4.15	13.	7.5	.37	-.19
05317	0900						12.1	5.09	15.	9.0	.39	-.16
05317	0930						12.1	4.45	15.	7.5	.38	-.15
05317	1400						7.72	.	3.4	.	.24	-.09
05317	1430						9.78	.	4.6	.	.26	-.13
05317	2130						7.35	.	.	.	.	.
05317	2230						6.61	.	13.	.	.37	-.08
06017	0900	18.38	18.30	18.31	71	70	2.44	2.13	17.	5.5	.37	-.08
06017	0930	18.39	18.28	18.21	71	71	2.78	2.33	15.	4.6	.35	-.09
06017	1000	18.63	18.63	19.02	70	67	.	.	.	.	.	.
06017	1030	18.67	.	19.61	70	64	.	.	.	.	.	.
06017	1100	18.50	18.69	19.54	66	59	.	.	.	.	.	.
06017	1130	18.56	19.04	19.76	68	61	.	.	.	.	.	.
06017	1200	18.59	18.75	20.43	67	61	.	.	.	.	.	.
06017	1230	18.83	.	20.18	66	59	.	.	.	.	.	.
06017	1300	.	.	.			.	.	.	.	.	.
06017	1330	.	.	.			.	.	.	.	.	.
06017	1400	18.34	18.38	18.30	68	69	.	.	.	.	.	.
06017	1430	18.80	18.78	.	58	57	.56	2.31	1.0	.70	.16	-.13
06017	1500	18.81	18.92	18.86	59	60	.68	1.88	.1	.46	.13	-.18
06017	1530	18.95	18.72	15.98	60	61	.	.	.	.	.	.
06017	1600	18.81	18.60	18.51	64	64	1.70	1.88	.27	.16	.10	-.26
06017	1630	19.30	18.79	18.56	61	63	.	.	.	.	.	.
06017	1700	19.10	18.79	18.59	61	64	2.31	1.69	.24	.14	.09	-.32
06017	1730	19.20	18.59	18.50	64	66	.	.	.	.	.	.
06017	1800	19.17	18.66	18.51	64	66	2.53	1.51	.19	.	.09	-.50
06017	1830	19.41	18.52	18.38	69	71	.	.	.	.	.	.
06017	1900	19.19	18.48	18.35	69	71	.	.	.	.	.	.
06017	1930	19.13	18.49	18.38	69	61	3.81	1.89	.19	.	.09	-.19
06017	2000	18.12	18.52	18.40	70	71	3.27	1.70	.19	.	.09	-.05
06017	2030	19.00	18.55	18.45	71	72	3.54	1.7	.13	.05	.07	-.24
06017	2100	18.96	18.53	18.41	75	75	2.77	1.51	.13	.09	.07	-.20
06017	2130	18.86	18.32	18.19	80	80	2.30	1.33	.16	.16	.09	-.20
06017	2200	18.85	18.14	18.04	82	82	2.20	1.33	.11	.07	.07	-.24
06017	2230	19.07	18.06	17.91	85	84	.	.	.	.		.
06017	2300	19.10	17.96	17.84	84	84	.	.	.	.		.
06017	2330	18.79	17.91	17.79	84	84	2.31	1.33	.17	.10	.08	-.25
06017	2400	18.82	17.90	17.75	83	84	2.88	1.42	.17	.09	.08	-.35
06027	0030	19.03	17.92	17.80	84	84	2.89	.	.19	.14	.09	-.35
06027	0100	19.14	17.94	17.81	85	85	2.42	2.00	.15	.12	.08	-.44
06027	0130	19.20	17.95	17.83	86	86	1.51	1.33	.13	.10	.08	-.62
06027	0200	19.16	18.06	17.94	86	86	1.89	1.67	.12	.11	.07	-.50
06027	0230	19.38	18.07	.	83	83	.	.	.	.	.	.
06027	0300	19.13	18.11	18.00	81	82	.	.	.	.	.	.
06027	0330	19.02	18.01	17.92	81	82	.	.	.	.	.	.
06027	0400	18.94	17.99	17.87	83	83	.	.	.	.	.	.

06027	0430	18.61	17.90	17.79	83	83	.	.	.	.	.	
06027	0500	18.72	17.89	17.79	85	85	.22	.25	.03	.	.04	-1.0
06027	0530	18.77	18.07	17.98	84	84	.36	.34	.03	.	.04	-1.0
06027	0600	18.78	18.24	18.13	81	82	.70	.75	.05	.	.04	-.86
06027	0630	18.81	18.42	18.22	78	80	.79	.75	.06	.	.06	-.62
06027	0700	18.91	18.48	18.25	79	81	.57	.66	.05	.	.05	-.77
06027	0730	19.06	18.52	18.27	77	80	.	.	.	.	.	.
06027	0800	19.40	18.55	18.34	77	79						
06027	0830	19.39	18.46	18.28	78	79						
06027	0900	19.42	18.40	18.26	77	78	2.09	1.92	.14	.	.07	-.68
06027	0930	19.67	18.40	18.29	77	78	1.79	1.46	.13	.	.07	-.77
06027	1000	19.65	18.43	18.35	77	78	2.00	1.62	.17	.	.08	.
06027	1030	20.03	18.57	18.46	77	77	2.31	2.69	.25	.	.10	-.83
06027	1100	19.95	18.56	18.55	78	78	2.77	2.67	.30	.	.10	-.80
06027	1130	19.88	18.76	18.70	78	78	2.53	.	.31	.	.10	-.44
06027	1200	20.19	18.84	18.80	80	79						
06027	1230	20.27	18.99	.	79	78						
06027	1300	19.90	19.19	19.18	75	74	5.53	1.14	.73	.34	.13	-.18
06027	1330	19.96	19.27	19.29	74	72	6.22	1.37	1.02	.50	.15	-.15
06027	1400	19.50	19.27	19.30	72	71	5.02	1.14	.84	.37	.14	-.09
06027	1430	19.65	19.23	19.20	74	74	5.36	1.29	.75	.33	.13	.
06027	1500	19.66	19.22	19.19	74	74	6.05	1.61	1.2	6.	.16	-.10
06027	1530	19.81	19.26	19.19	74	74	5.69	1.79	1.4	.7	.17	-.10
06027	1600	19.85	19.31	19.19	75	75	6.05	1.97	1.8	.75	.18	-.09
06027	1630	19.78	19.24	19.02	78	78						
06027	1700	19.73	19.14	18.97	78	79						
06027	1730	19.86	19.06	18.94	79	79						
06027	1800	19.82	19.03	18.93	79	79						
06027	1830	19.48	19.01	18.93	82	81						
06027	1900	19.56	.	18.88	82	82						
06027	1930	19.34	.	18.87	85	84						
06027	2000	19.39	18.97	18.90	85	84						
06027	2030	19.49	18.97	18.97	83	83						
06027	2100	19.52	18.89	.	84	83						
06027	2130	19.49	13.70	18.85	83	82						
06027	2200	19.61	18.97	18.90	85	84						
06027	2230	19.53	18.98	18.90	87	86						
06027	2300	19.66	19.04	18.95	86	86						
06027	2330	19.71	19.08	18.97	84	84						
06027	2400	19.17	19.16	19.05	85	85						
06037	1230	19.45	19.61	19.91	80	79	2.05	1.12	4.9	2.7	.26	
06037	1200	19.53	19.65	19.61	80	79						
06037	1200	19.53	19.65	19.61	80	79						
06037	1300	.	.	.								
06037	1330	.	.	.								
06037	1400	19.53	19.19	19.03	75	76	5.25	2.97	36.	.	.52	-.01
06037	1430	19.61	18.98	18.94	75	75	5.25	2.74	33.	.	.51	-.02
06037	1500	19.49	19.24	19.19	74	75	5.42	2.32	28.	.	.48	-.02
06037	1530	19.83	19.74	20.18	73	72						
06037	1600	19.51	19.65	20.37	75	68						
06037	1630	19.43	19.36	21.78	75	71						
06037	1700	19.49	19.21	20.93	77	71						
06037	1730	19.59	18.96	.	77	68						
06037	1800	19.52	18.96	20.16	79	71						
06037	1830	19.43	18.47	19.52	80	74						
06037	1900	19.55	19.02	19.47	79	76						
06037	1930	19.38	19.09	19.50	79	76						
06037	2000	20.22	19.30	19.53	80	79						
06037	2030	20.13	19.50	19.39	79	76						
06037	2100	19.91	19.34	21.11	75	71						
06037	2130	19.88	19.19	19.11	74	74	4.31	.	19.	.	.42	-.03
06037	2200	19.77	19.09	18.84	77	77	3.87	.	19.	.	.42	-.03
06037	2230	19.79	19.12	19.07	77	73						
06037	2300	20.26	19.14	19.28	78	75						
06037	2330	20.42	19.10	20.90	80	76						
06037	2400	20.45	19.19	19.34	77	75						
06047	0630	19.97	19.86	19.61	73	71	7.02	.	7.5	.	.31	-.03
06047	0700	19.97	19.84	19.59	69	69	7.21	.	8.5	.	.32	-.03
06047	0730	20.15	20.04	20.04	70	68	.	.	.	.	.	.
06047	0800	20.35	.	19.99	73	71	.	.	.	.	.	.
06047	0830	.	19.66	19.70	71	71	5.25	.	3.7	.	.25	-.06
06047	0900	20.33	19.73	19.69	72	72	4.77	.	5.5	.	.28	-.05
06047	0930	20.27	20.15	20.11	70	69						
06047	1000	20.10	20.35	20.47	72	71						

06047	1030	19.90	20.33	20.54	70	69						
06047	1100	20.18	20.70	20.42	70	69						
06047	1130	20.37	20.67	20.47	73	71						
06047	1200	20.43	20.78	20.57	72	70						
06047	1230	20.58	20.79	21.78	72	65						
06047	1300	9.14	20.77	20.66	72	69						
06047	1330	10.77	20.99	20.99	71	66						
06047	1400	20.09	20.65	25.58	71	62						
06047	1430	20.09	20.10	20.04	70	70	3.76	.	15.	.	.39	-.01
06047	1500	20.08	20.12	20.04	68	70	4.16	.	13.	.	.37	-.01
06047	1530	20.26	20.40	20.58	72	70						
06047	1600	20.61	20.51	20.42	70	68						
06047	1630	20.37	20.51	22.29	68	60						
06047	1700	20.70	20.39	21.63	71	76						
06047	1730	20.54	20.17	21.43	72	63						
06047	1800	20.64	19.94	12.54	72	69						
06047	1830	21.19	20.09	.	72	72						
06047	1900	20.61	19.96	19.57	73	71						
06047	1930	20.49	19.64	10.54	72	72						
06047	2000	20.48	19.70	19.63	71	72						
06047	2030	20.44	19.82	.	72	72	4.11	.	6.5	.	.29	-.05
06047	2100	20.43	19.71	.	70	70	5.17	.	10.	.	.34	-.04
06047	2130	20.59	19.58	19.55	70	70						
06047	2200	20.58	19.55	19.49	70	70						
06047	2230	20.45	19.61	19.47	70	69						
06047	2300	20.61	19.47	19.37	72	72						
06047	2330	20.70	19.54	19.44	70	70						
06047	2400	20.42	19.49	19.46	71	71						
06057	0830	20.75	19.98	20.04	66	67	4.87	3.30	4.4	2.1	.25	-.08
06057	0900	20.77	20.11	20.06	60	61	5.12	4.27	3.9	2.5	.25	.02
06057	0930	20.75	20.20	20.17	62	63						
06057	1000	20.98	20.72	20.23	77	66						
06057	1030	20.81	20.16	20.31	62	62						
06057	1100	20.81	20.30	20.35	66	64						
06057	1130	20.85	20.26	.	65	65						
06057	1200	20.79	20.41	20.35	65	65						
06057	1230	21.14	20.38	20.38	65	65						
06057	1300	21.31	20.45	20.42	65	65						
06057	1330	21.27	20.39	.	66	66						
06057	1400	21.26	20.59	20.34	67	68						
06057	1415						6.13	4.40	5.5	3.6	.29	-.07
06057	1430	20.85	20.65	20.66	67	68	6.62	4.02	5.5	2.2	.27	-.06
06057	1445						5.80	4.02	6.4	2.8	.28	-.04
06057	1500	20.75	20.51	20.46	65	66	6.97	4.40	6.3	3.2	.29	-.05
06057	1530	20.83	20.34	20.65	71	70						
06057	1600	21.03	20.58	20.76	71	69						
06057	1630	21.02	20.33	20.22	70	70						
06057	1700	21.10	20.22	20.28	71	70						
06057	1730	21.15	20.18	20.45	71	70						
06057	1800	21.08	20.20	20.15	72	71						
06057	1830	20.98	20.16	20.04	71	72	6.97	3.77	2.8	1.9	.22	-.11
06057	1900	21.03	20.09	20.02	68	69	8.82	4.40	2.2	1.1	.20	-.06
06057	1930	21.01	20.13	20.02	69	69	7.68	4.50	1.8	.95	.19	-.14
06057	2000	20.91	20.07	19.99	65	67	7.32	4.27	1.2	.70	.17	-.22
06057	2030	21.03	20.07	19.95	66	68	6.97	3.41	.95	.75	.16	.
06057	2100	21.00	20.14	20.01	66	67	8.82	4.5	1.3	.85	.17	-.17
06057	2130	21.14	20.16	20.05	66	67	8.06	4.8	1.4	1.0	.18	-.17
06057	2200	21.06	20.11	19.99	67	68	7.68	4.8	1.3	.8	.17	-.23
06057	2230	20.88	19.97	19.89	63	65	6.29	4.14	.8	.41	.14	-.29
06057	2300	20.93	19.86	19.79	66	67	6.80	4.67	1.1	.7	.17	-.26
06057	2330	20.91	19.87	19.78	64	65	8.43	5.08	1.2	.8	.17	-.24
06057	2400	21.14	19.84	19.73	66	67	7.50	4.80	1.3	.8	.17	-.26
06067	0030	21.24	19.88	19.79	65	67	8.06	4.29	1.8	1.0	.19	-.19
06067	0100	21.10	.	19.68	64	65	8.63	5.37	2.6	1.4	.21	-.14
06067	0130	20.84	19.73	19.67	63	65	10.0	6.75	2.9	1.5	.21	-.13
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06067	0230	20.61	19.64	19.56	62	64						
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06067	0330	20.90	19.72	19.62	62	64						
06067	0400	20.47	19.69	19.61	60	61	10.4	7.3	4.4	2.0	.25	-.10
06067	0430	21.20	19.87	19.78	56	58	12.3	13.8	4.9	1.8	.25	-.15
06067	0500	21.37	20.21	20.05	54	57	13.8	13.1	4.8	2.1	.25	-.14
06067	0530	21.08	20.41	20.24	49	52	13.8	12.4	3.9	1.6	.24	-.13
06067	0600	20.22	20.34	20.17	46	46	9.6	11.0	4.5	1.8	.24	-.07

06067	0630	20.11	20.30	20.16	51	51	8.3	9.8	4.0	1.7	.24	-.06
06067	0700	20.10	20.31	20.24	50	48						
06067	0730	20.97	20.26	20.21	50	49						
06067	0800	20.72	20.27	20.26	51	49						
06067	0830	20.99	.	20.23	60	63						
06067	0900	20.98	20.38	20.39	55	54						
06067	0930	20.95	20.32	20.31	55	48						
06067	1000	21.00	20.31	20.32	57	57						
06067	1030	20.90	20.25	20.25	58	60						
06067	1100	20.75	20.21	20.22	58	59						
06067	1130	20.85	20.24	20.21	57	59						

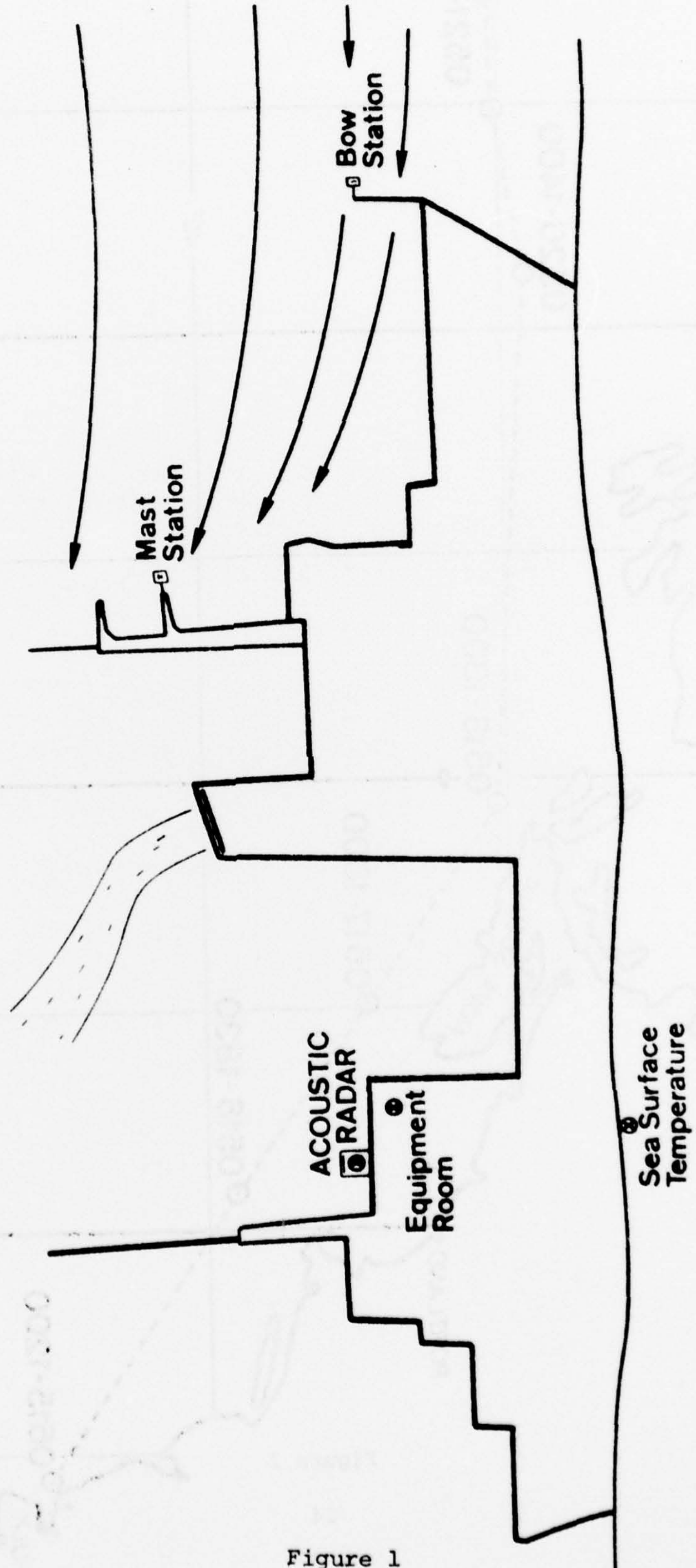

Bow Station
Mast Station
ACOUSTIC RADAR
Equipment Room
Sea Surface Temperature

Figure 1

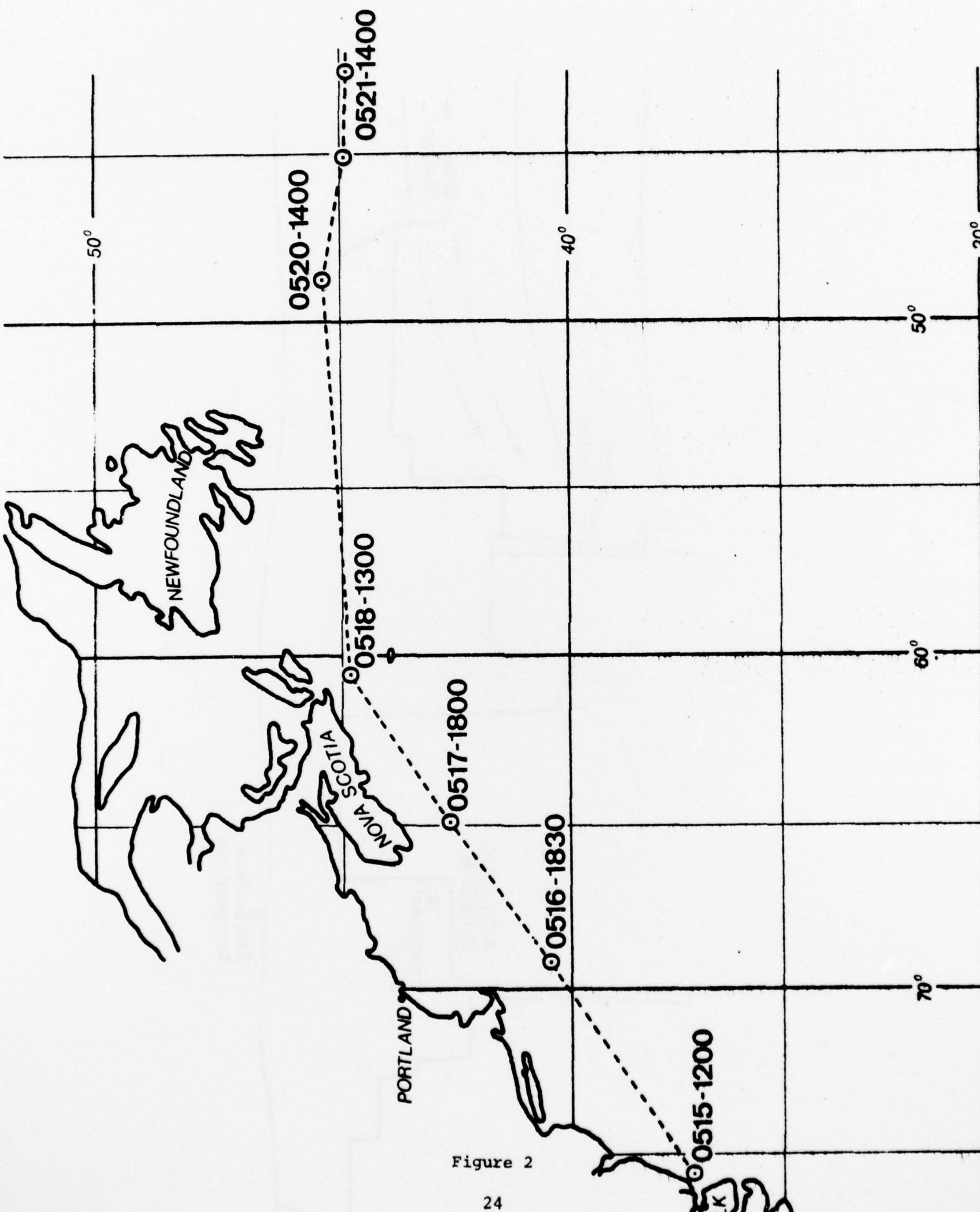
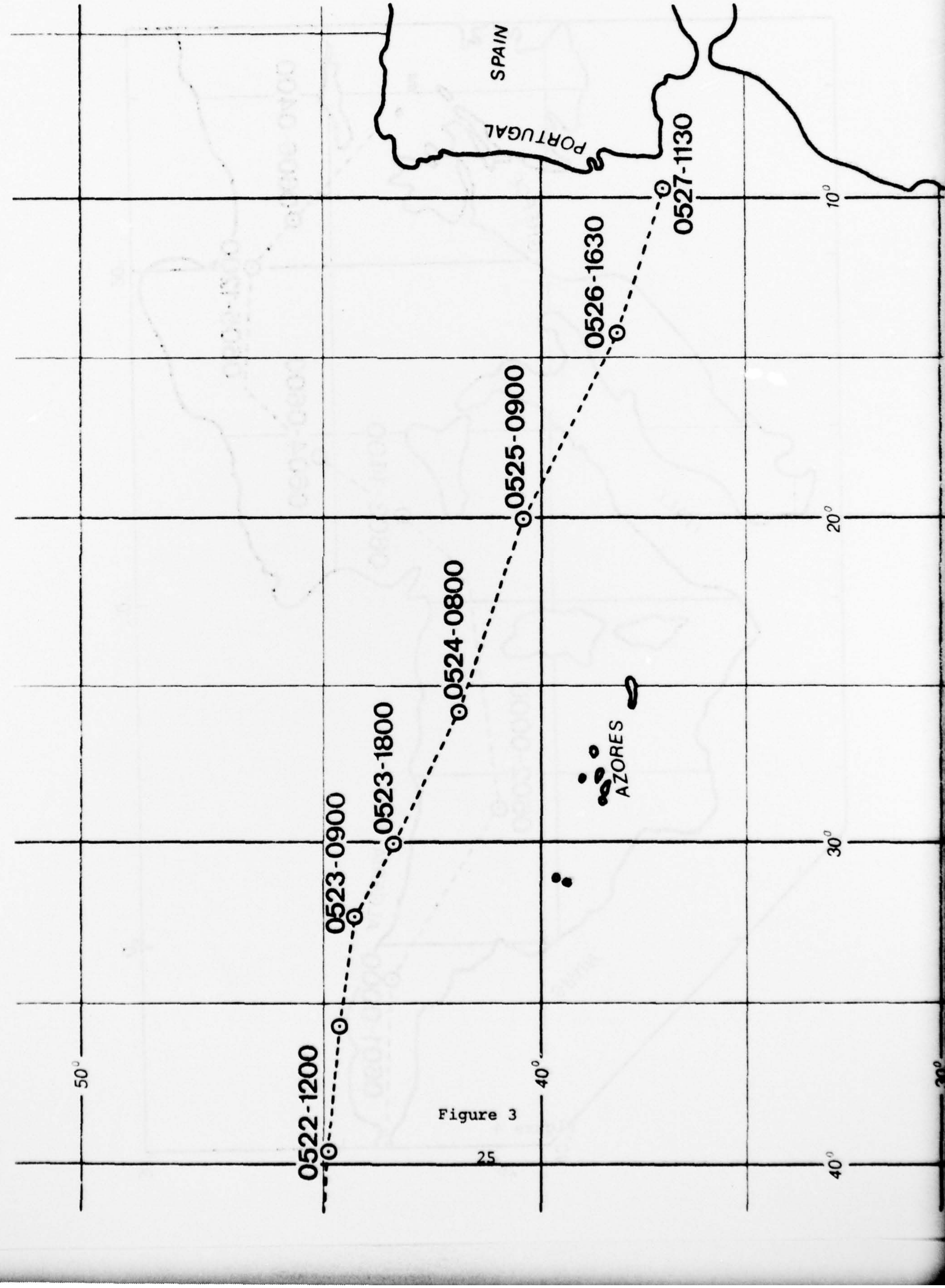

NEWFOUNDLAND
NOVA SCOTIA
PORTLAND
0515-1200
0516-1830
0517-1800
0518-1300
0520-1400
0521-1400
50°
40°
30°
50°
60°
70°

Figure 2



SPAIN
PORTUGAL
AZORES
0522-1200
0523-0900
0523-1800
0524-0800
0525-0900
0526-1630
0527-1130
50°
40°
30°
10°
20°
30°
40°

Figure 3

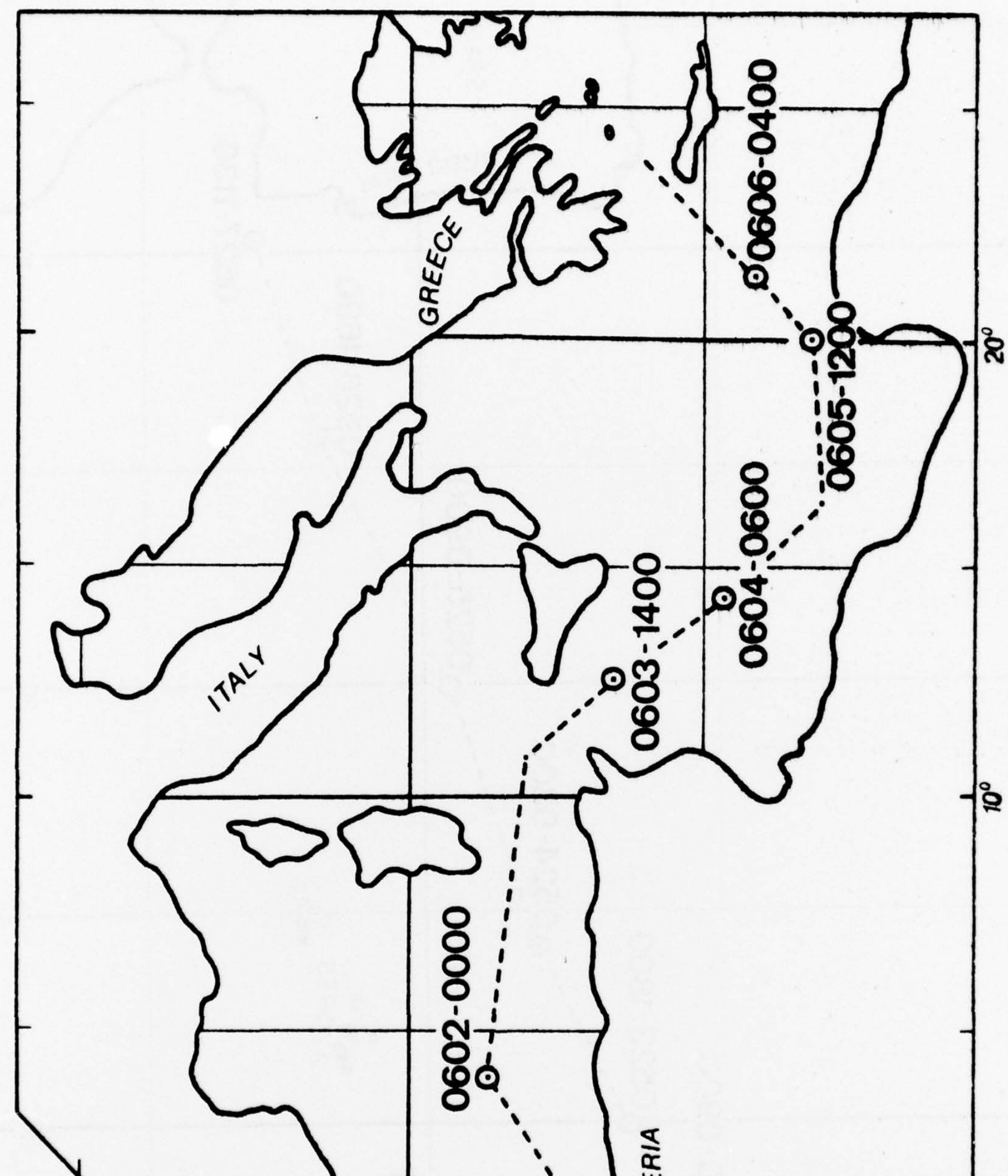
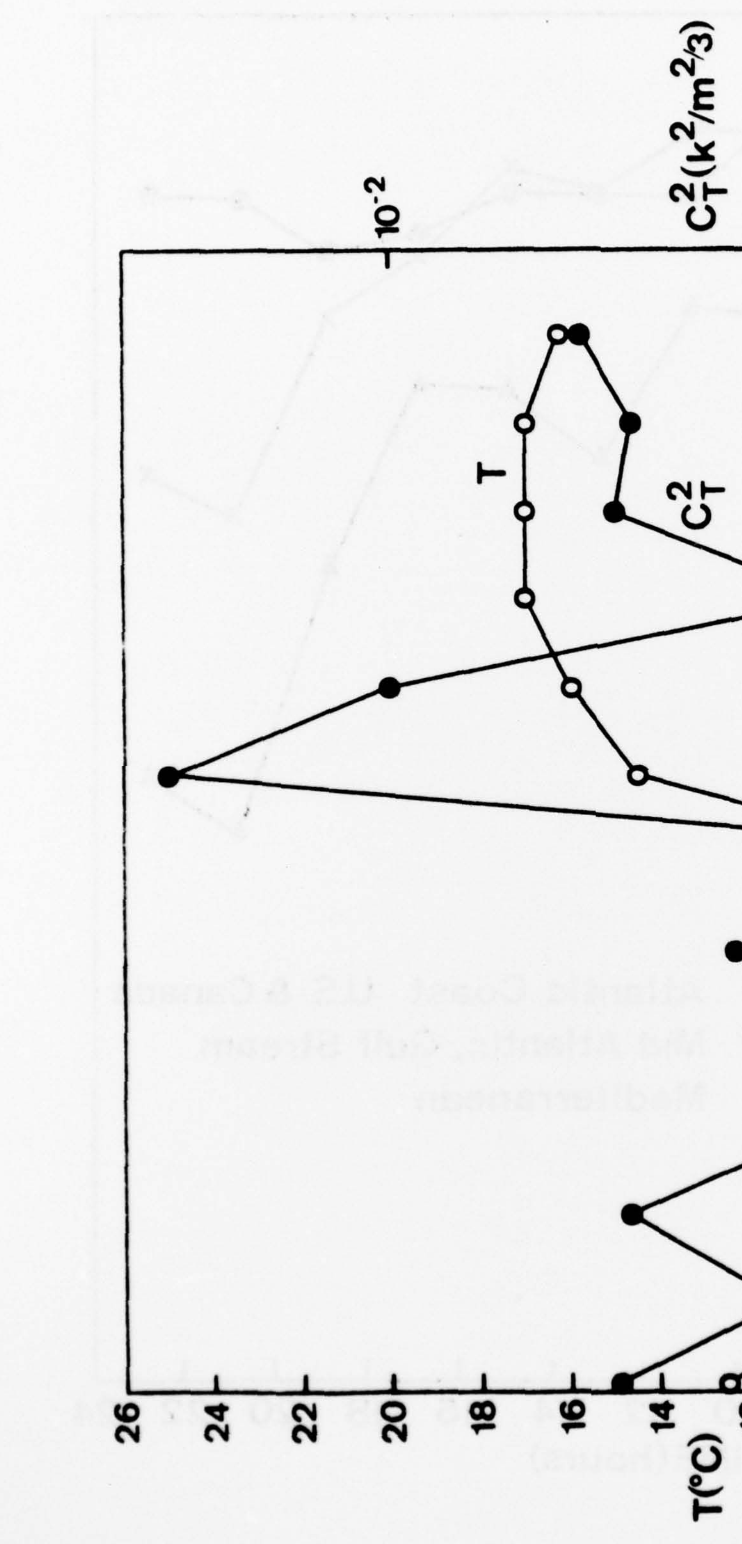
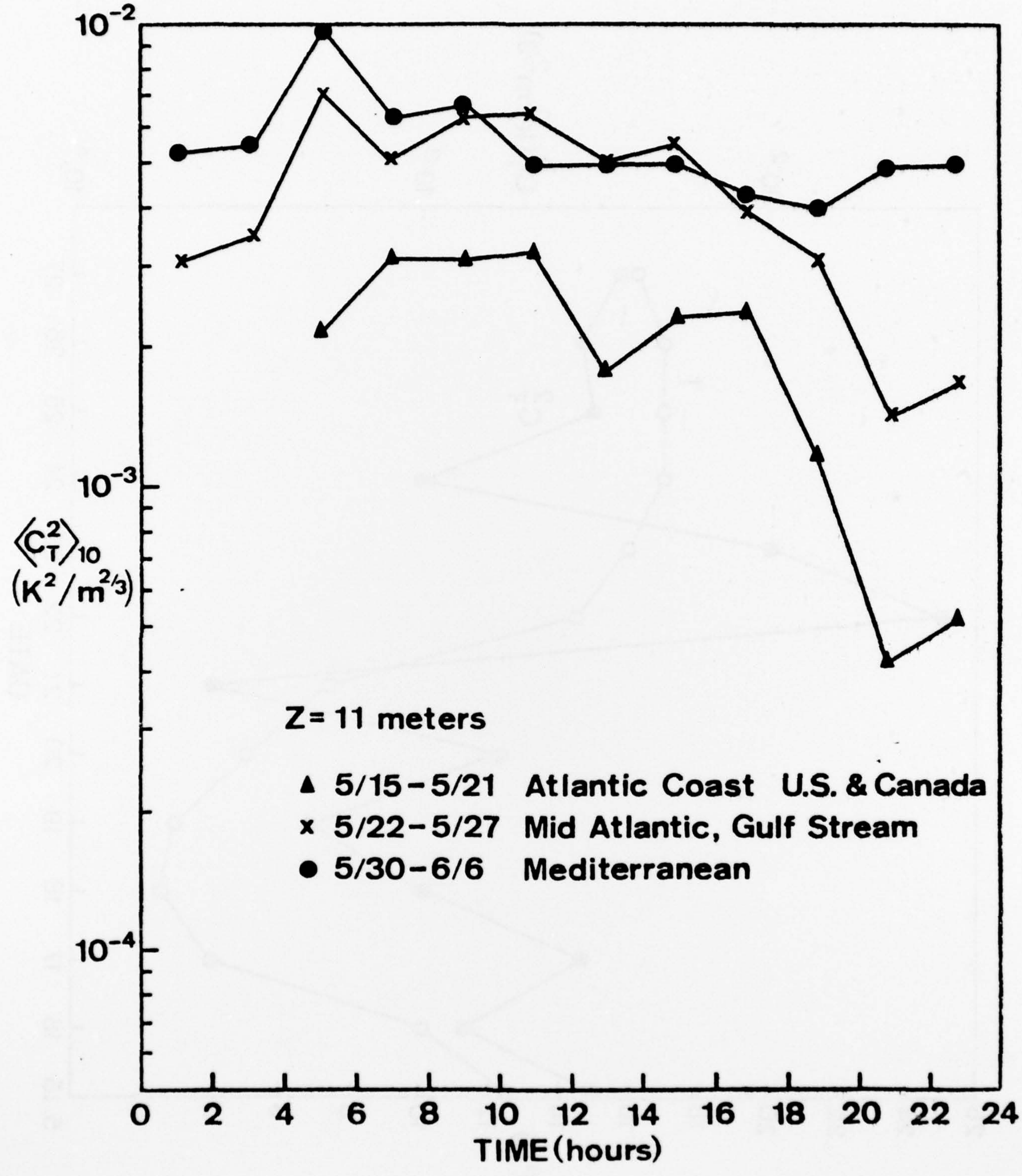

SPAIN
ALGERIA
ITALY
GREECE
0601-0000
0602-0000
0603-1400
0604-0600
0605-1200
0606-0400
0°
10°
20°
30°
40°

Figure 4



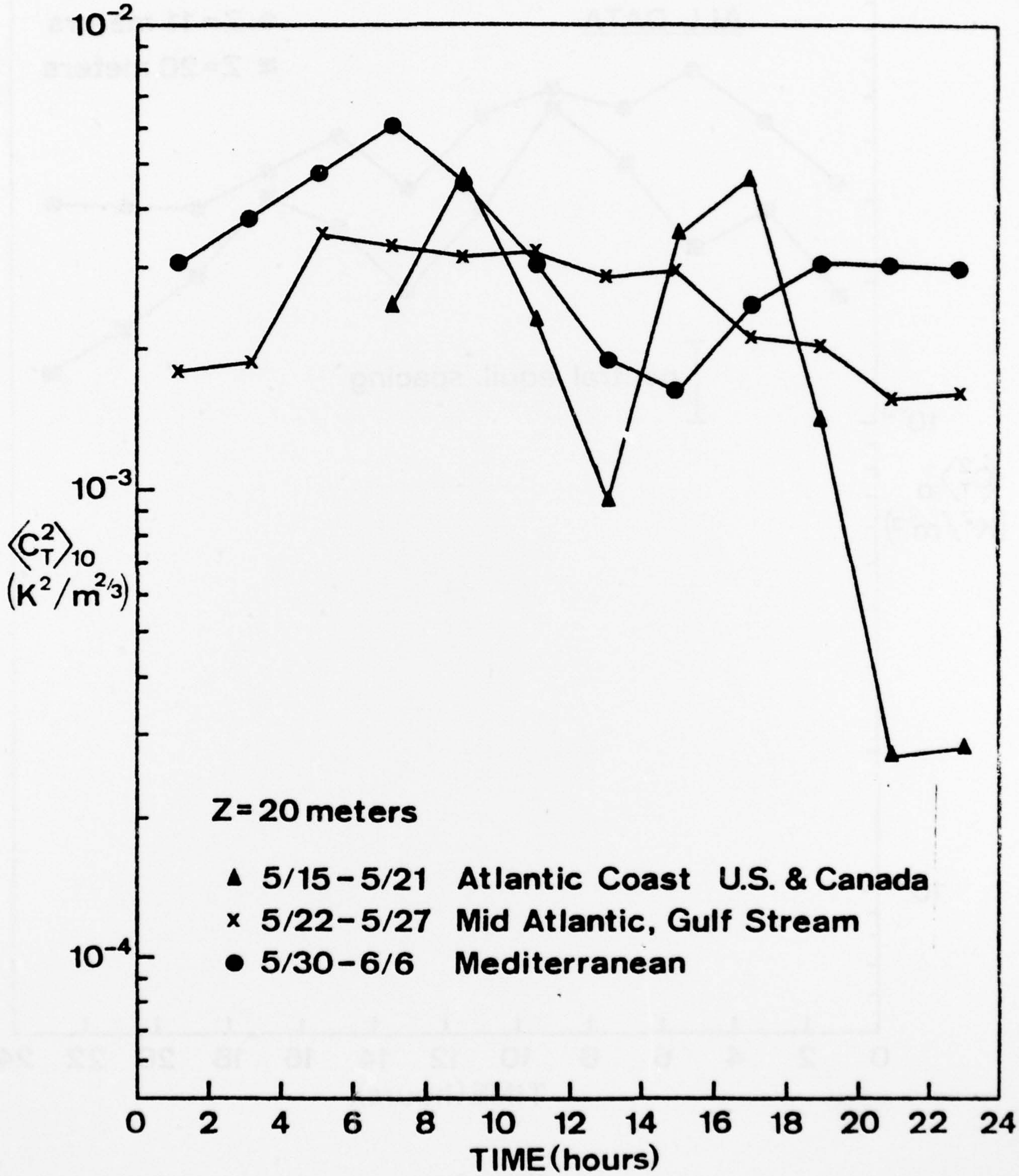
T(°C)
26
24
22
20
18
16
14
12
10
8
6
4
2
5/15
16
17
18
19
20
21
22
23
24
25
26
27
DATE
$C_T^2 (k^2/m^{2/3})$
10^{-2}
10^{-3}
10^{-4}
T
C_T^2

Figure 5



10^{-2}
10^{-3}
10^{-4}
$\langle C_T^2 \rangle_{10}$
$(K^2/m^{2/3})$
Z= 11 meters
▲ 5/15-5/21 Atlantic Coast U.S. & Canada
x 5/22-5/27 Mid Atlantic, Gulf Stream
● 5/30-6/6 Mediterranean
0 2 4 6 8 10 12 14 16 18 20 22 24
TIME (hours)

Figure 6



10^{-2}
10^{-3}
10^{-4}
$\langle C_T^2 \rangle_{10}$
$(K^2/m^{2/3})$
Z=20 meters
▲ 5/15-5/21 Atlantic Coast U.S. & Canada
× 5/22-5/27 Mid Atlantic, Gulf Stream
● 5/30-6/6 Mediterranean
0 2 4 6 8 10 12 14 16 18 20 22 24
TIME (hours)

Figure 7

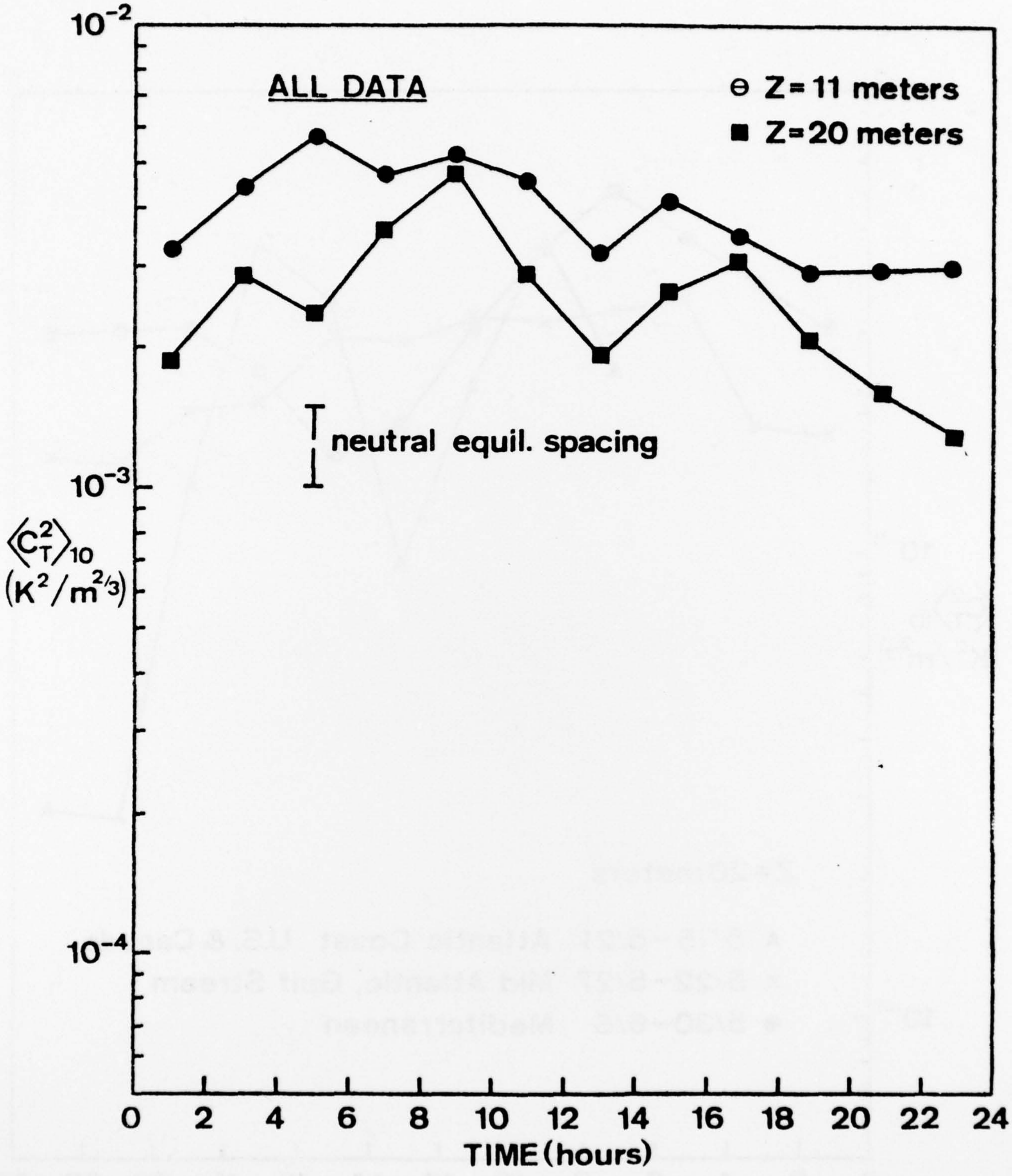

ALL DATA
Z=11 meters
Z=20 meters
neutral equil. spacing
10^{-2}
10^{-3}
10^{-4}
$\langle C_T^2 \rangle_{10}$
$(K^2/m^{2/3})$
0 2 4 6 8 10 12 14 16 18 20 22 24
TIME (hours)

Figure 8

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